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Integrated Crop-Livestock Farming

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INTRODUCTION

Agriculture is an important sector when it comes to food security, employment opportunities, and economic growth. However, traditional agricultural practices depend upon external factors like chemical fertilizers, pesticides, purchased feed, and fossil fuel usage. Repeated cultivation of the same crops without sufficient nutrient replenishment results in degraded soils, decreased soil fertility, low biodiversity, and pollution of environment. Livestock rearing systems that are kept apart from cropping may have issues related to feed availability and waste disposal. Integrated Crop-Livestock Farming System (ICLF) provides a way to overcome such problems in a systematic and efficient manner. ICLF involves the coordination between crop cultivation and animal rearing processes. In this process, crops and animals are regarded as interrelated systems rather than independent ones. Residues of crops are used as feed for animals, while excreta of animals are used as organic manure. Incorporation of crops and livestock results in circular production process where waste or residues from one system become input for another. Some examples are utilization of wheat straw, paddy straw, maize stover, and pulses residue as livestock feed, while animal dung and urine is used for composting and biogas production purposes.

In India, where a large proportion of farmers possess small and fragmented landholdings, integrated crop-livestock farming has considerable potential. It provides opportunities for income diversification, improves household nutritional security, and increases resilience against climatic and market uncertainties.

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2. Integrated Crop-Livestock Farming - Concept and Components

Integrated Crop-Livestock Farming can be defined as a farming technique wherein crop production and raising of livestock are combined in a manner that maximizes output through optimal resource utilization. The basic purpose is to create a perfect balance between the two enterprises so that both become equally responsible for the sustenance of the farm. The main components of the integrated farming system are:

2.1 Crop Production

Crop production is the main component of the integrated system. Different kinds of cereals, pulses, oil seeds, vegetables, fruits and fodder crops are grown depending upon the soil and climatic condition of the area. Crop residue and byproducts are very useful for livestock feed. Mainly these crops are:

- ✓ Cereals such as wheat, rice, maize and sorghum.
- ✓ Pulses like chick pea, lentil, pigeon pea and green gram.
- ✓ Oil seeds such as mustard, soyabean and groundnut.
- ✓ Fodder crops such as berseem, lucerne, sorghum and maize.
- ✓ Vegetables and fruit crops.

2.2 Livestock Production

Livestock is one important aspect that provides additional income and organic materials for crop production. Based on farmers' resources and local circumstances, different types of livestock enterprises may be introduced.

- ✓ Milk farming: Milk production from cattle and buffaloes provides milk, manure, and income.
- ✓ Goat farming: Goats can be kept by small and marginal farmers due to their hardiness and lower cost at beginning.
- ✓ Sheep farming: Meat, wool, and manure from sheep can be obtained especially in dry and semi-arid areas.
- ✓ Poultry farming: Eggs, meat, and nutrient-rich litter can be produced through poultry.

- ✓ Pig farming: There can be income generating activities through pig production.

2.3 Fodder Production and Management

Fodder is an important requirement for successful livestock production. Growing fodder crops along with food crops is a way to avoid purchased fodder. Green fodder, dry fodder, fodder from crop residues and fodder from trees may be included in the diet of livestock.

2.4 Organic Manure and Waste Management

Farmers can convert livestock wastes like manure, urine, and other organic bedding materials into farmyard manure, compost, and vermicompost.

3. Models of Integrated Cropping and Livestock Farming

Various models of integrated cropping and livestock farming may be employed based on land availability, climate, marketing aspects, and farmers' financial position.

3.1 Crop-Dairy Farming Model

In this model, cultivation of different crops and dairy farming are combined. Crops like wheat, rice, maize, and fodder crops are raised along with cattle and buffaloes that are raised for milk production. Crops' leftovers serve as animal feed, and livestock manure acts as organic manure for agriculture farms. This model suits small and medium scale farmers more.

3.2 Crop-Goat Farming Model

Farmers may integrate goat rearing with crop farming, particularly in arid and rainfed areas. Goats feed on tree foliage, shrubs, and specific agricultural produce. Their manure helps in making soil fertile. This model needs relatively less land area.

3.3 Crop-Poultry Farming Model

Poultry can be integrated with crops such as cereals, vegetables, and horticultural crops. Poultry litter serves as a rich source of organic nutrients, and crops also produce agricultural waste products which can be used as a component in poultry feeding.

3.4 Crop-Sheep Farming Model

The model is appropriate for dry and semi-arid regions, where sheep can make use of grazing lands and agricultural wastes, besides contributing towards nutrient recycling through their manure. Grazing should be properly managed in order to avoid overgrazing.

3.5 Crop-Dairy-Poultry-Vegetable Farming Model

It is a diversified model of farming system where crop production, dairy, poultry, and vegetable cultivation are combined together. Manure from dairy farm animals, extra income from poultry farming and cash income from vegetables are some of the benefits of this model.

4. Recycling of Resources in Integrated Crop-Livestock Farming

Recycling of resources is an important principle of integrated crop-livestock farming. It makes sure that agricultural byproducts are recycled and made into useful products, thus reducing wastage and lowering the cost of production.

4.1 Recycling of Agricultural Residues for Livestock Feeding

Agricultural residues like wheat straw, paddy straw, maize stover, sorghum stover, and pulses haulm can be used for animal feeding. These agricultural residues help in meeting the requirements of roughages for the animals. But there might be need to chop, treat, and supplement them properly for better digestion.

4.2 Recycling of Animal Manures

The manure of animals includes essential plant nutrients such as nitrogen, phosphorus, and potassium. They can be used for making farm yard manures and composts. Regular use of organic manure results in improved soil structure and biological activity.

4.3 Vermicomposting

Decomposed organic matter, including animal manure and crop residues, is converted into nutritious vermicompost by earthworms. Vermicomposting is one of the best ways of recycling farm waste and making organic manure for use in vegetables, fruits, and field crops.

4.4 Biogas Generation

Animal manure is used in the generation of biogas using the anaerobic process. Biogas acts as a source of renewable energy which is used for cooking, heating, and other domestic activities. The slurry left behind becomes an organic fertilizer.

4.5 Nutrient Cycling Using Fodder Livestock System

Fodder crops grown on the farm are fed to animals as green fodder, while manure from animals acts as a source of organic nutrients for the fodder crops. Thus, there is a continuous cycle of nutrients in the system.

5. Advantages of Integrated Crop and Livestock Farming

Integration of crops and livestock provides several economic, environmental, and social advantages that promote the sustainable nature of agricultural production.

5.1 Increased Agricultural Production

The integration of crops and livestock results in increased productivity due to efficient use of resources like land, labor, water, etc. The farmer gets various types of products from one single farm such as food grain, vegetables, milk, meat, eggs, and manure.

5.2 Improvement in Soil Fertility

The use of organic manure produced through livestock operations increases the fertility of soil. Organic manures improve the physical, chemical and biological properties of the soil.

5.3 Decrease in the Cost of Production

The use of the resources available within the farm reduces cost spent on synthetic fertilizers, bought fodder, and other external inputs. Crop residues are used as livestock feed whereas manure of animals is used for providing nutrients to the soil.

5.4 Extra Income and Employment Opportunities

Livestock operations generate extra income through sale of milk, eggs, meat and other livestock products. The income generation from livestock operations is consistent unlike seasonal income from crop production. The dairy and poultry sector generate income all year around.

5.5 Risk Mitigation Through Income Diversification

Reliance on a single crop increases vulnerability to risks resulting from drought, flooding, attacks by pests, diseases, and fluctuations in markets. Integrated agriculture mitigates the risk through diversification of agricultural enterprises. Where crop production is hampered by bad weather, livestock production offers an alternate source of income.

5.6 Environmental Sustainability

Recycling of crop residues and manure from livestock minimizes the generation of agricultural wastes and enhances nutrient management. Biogas production offers a source of renewable energy, minimizing the degradation of livestock waste. Integration also helps promote environmental sustainability by supporting biodiversity.

5.7 Enhanced Food Security

Integrating crops and livestock ensures that households get access to diverse sources of nutritious foods. Crop production generates cereal, legumes, fruits, and vegetables, whereas livestock produce milk, eggs, and meat.

6. Role of Integrated Crop-Livestock Farming in Climate-Smart Agriculture

Climate change is one of the most important issues that have recently surfaced as a problem to agriculture production. Rising temperatures, variable rainfall patterns, droughts, floods, and other weather-related changes have adverse effects on crop and livestock production. However, integrated crop-livestock farming can play its role in climate adaptation and mitigation provided that it is done in the right way.

Climate adaptation: The diversification of crop and livestock enterprises helps farmers decrease their vulnerability to climatic risks. Crops resistant to droughts, conservation of fodder, the preparation of silage, and proper housing of animals help keep up farm production under different climatic conditions.

Climate mitigation: Effective manure management, the production of biogas, improved feeding practices, and good nutrient management can minimize greenhouse gas emissions per unit of agricultural production. Agroforestry and incorporation of fodder trees may also assist in carbon sequestration.

Resource efficiency: Water harvesting, micro-irrigation, conservation agriculture, and efficient fodder management can improve water use efficiency.

CONCLUSION

The approach of Integrated Crop-Livestock Farming is an ideal way of realizing sustainable agricultural development by integrating effectively agriculture production and animal rearing systems. The approach encourages resource recycling, helps in improving soil fertility, increases farm productivity, reduces costs of production and offers diversified income options. The recycling of crop residue for use as livestock feed and animal manure as fertilizer creates a circular agriculture practice that avoids wastage of any resource. Even though limitations like land availability, fodder availability, higher capital requirements, animal diseases and marketing problems hinder the practice of integrated farming, but these barriers can be overcome by adopting scientific ways and using better technology. Emphasis on the location-based integrated farming practice, climate smart techniques and efficient resource utilization would go a long way in strengthening our agricultural sector. Therefore, integrated crop-livestock farming should be practiced as an important tool for improvement of farmers' lives, nutritional security, conservation of natural resources and building a resilient agriculture system in India.

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